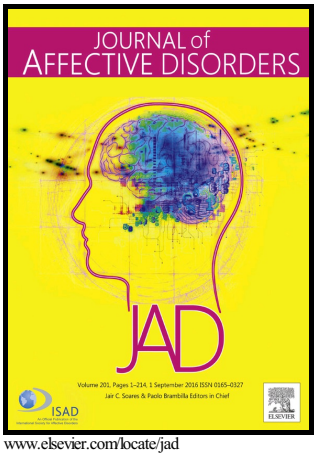

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Journal of Affective Disorders

Correlates of sedentary behavior in 2,375 people with depression from 6 low- and middle-income countries

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Abstract

Objective: Sedentary behaviour (SB) is harmful for health and well-being and may be associated with depression. However, little is known about the correlates of SB in people with depression. Thus, we investigated SB correlates among community-dwelling adults with depression in six low- and middle-income countries.

Methods: Cross-sectional data from the World Health Organization's Study on Global Ageing and Adult Health were analyzed. The analysis was restricted to those with DSM-IV Depression or receiving depression treatment in the last 12 months. Self-reported time spent sedentary per day was the outcome. High SB was defined as ≥8 hours of SB per day. The correlates (sociodemographic and health-related) of SB were estimated by multivariable linear and logistic regression analyses.

Results: In 2375 individuals with depression (mean age=48.0 years; 60.7% female), the prevalence of high SB was 11.1% (95%CI=8.2%-14.9%), while the mean (±SD) time spent sedentary was 215 (±192) minutes per day. Socio-demographic factors significantly associated with high SB were older age and being unmarried, being male and being unemployed. In other domains, no alcohol consumption, current smoking, mild cognitive impairment, bodily pain, arthritis, stroke, disability, and lower levels of social cohesion, COPD, visual impairment, and poor self-rated health was associated with greater time spent sedentary.

Conclusion: Our data suggest that future interventions seeking to reduce SB among individuals with depression may target at risk groups based on identified sociodemographic correlates while the promotion of social cohesion may have the potential to increase the efficacy of future public health initiatives. From a clinical perspective, bodily pain and somatic co-morbidities need to be taken into account.

Keywords: sedentary; sitting; depression

Introduction

Depression is globally the leading cause of years lived with disability (Whiteford et al., 2015). Although depression is also associated with elevated premature mortality partly due to suicide (Hawton et al., 2013), cardio-metabolic and respiratory diseases are the most important causes of premature death (Correll et al., 2017; Cuijpers and Smit, 2002). People with depression are at twice the risk of having cardio-metabolic diseases versus the general population

(Stubbs et al., 2017c; Vancampfort et al., 2016; Vancampfort et al., 2015a). Moreover, those with depression often have poorer physical health including elevated risk of multimorbidity and pain (Stubbs et al., 2017d).

There is increasing evidence demonstrating that sedentary behavior (SB) is associated with a wide range of deleterious outcomes in adults such as diabetes, stroke, associated premature mortality (Biswas et al., 2015), independently of physical activity levels. SB refers to any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture (Tremblay et al., 2017). SB is highly prevalent across the world (Ekelund et al., 2016b; Loyen et al., 2016). In addition to the deleterious physical health consequences of SB (Wirth et al., 2017) including an increased risk of multimorbidity (Loprinzi, 2015), there is also an increasing evidence base suggesting its association with depression. A recent meta-analysis, almost exclusively among high-income countries, found that among more than 110,000 individuals, higher levels of SB were associated with a higher risk for developing depression (relative risk 1.31 (95%CI 1.16 to 1.48)) (Zhai et al., 2015). Vice versa, people who are diagnosed with depression spent 25.6 (95%CI8.5-42.7) more daily minutes in SB than non-depressed participants. This discrepancy is most notable in adults aged ≥65 years (35.6 minutes in those with depression) (Stubbs et al., 2018). Overall, adjusting for socio-demographics and country, depression is associated with a 1.94 (95%CI1.31-2.85) times higher odds for high SB (i.e., ≥8h/day) (Stubbs et al., 2018).

Despite the increased emphasis in the literature on the important physical and mental health benefits of reducing time spent sedentary and the higher risk for SB in people with depression (Schuch et al., 2017), there is a paucity of studies investigating correlates of SB in people with depression.

Identifying correlates of SB in people with depression can aid in the development of successful SB reduction interventions in this population by highlighting the potentially modifiable correlates that may bring about reductions in SB (e.g. physical environment), or identify characteristics of specific subgroups most in need of intervention (e.g. demographics). Evidence from the general population in high income countries has provided some support for sociodemographic and health correlates of SB, including older age, lower education, being unemployed, female gender, a higher body mass index (BMI), a lower income, smoking, and the presence of depressive symptoms (O'Donoghue et al., 2016; Rhodes et al., 2012). However, special attention should be given to people with depression in whom the antecedents and consequences of SB may differ due to their illness (O'Donoghue et al., 2016; Prince et al., 2017). To the best of our knowledge, such evidence is currently lacking.

Furthermore, exploring SB correlates in people with depression in low- and middle-income countries (LMICs) is particularly important given the increasing rates of non-communicable diseases and sedentary lifestyles (Christensen et al., 2009) and the high prevalence of depression (Guerra et al., 2016) in this setting. Also, compared

to high-income countries, there may be lower levels of knowledge regarding the risks associated with SB (Pengpid et al., 2015) and different socio-cultural structures (e.g. active outdoor leisure time mostly only accepted for men) and environmental factors (e.g., higher crime rates, bad climate conditions) (Atkinson et al., 2016) which may impact SB. The continuing dearth of studies from LMICs also highlights the gap between where research is conducted and where the largest public health impacts of SB will occur in the future (Sallis et al., 2016). Understanding sociodemographic factors (e.g. age, sex, employment status, marital status, social cohesion), mental/physical health conditions (e.g. physical comorbidities) and health behaviors (e.g. smoking, alcohol use) that are related with higher levels of SB among individuals with depression may prove useful for developing effective interventions for vulnerable populations in LMICs. The current study used a large, multi-national sample and sought to investigate SB correlates among community-dwelling adults with depression in six LMICs.

Methods

The survey

The current analyses utilizes data from the Study on Global Ageing and Adult Health (SAGE) survey (Wave 1). All interested researchers may seek access to this dataset through the World Health Organization (WHO) website (http://www.who.int/healthinfo/sage/en/). Interviews and performance tests were undertaken between 2007 and 2010 in China, Ghana, India, Mexico, Russia, and South Africa, which were all LMICs at the time of the survey according to the World Bank classification (Bank, 2003). Details of the survey methodology are provided elsewhere (Kowal et al., 2012). In brief, following a standard research protocol across countries, trained interviewers conducted face-to-face interviews using a standard questionnaire to collect information with either the use of a computer-assisted personal interview (CAPI) or a paper and pencil interview (PAPI) depending on the setting. Standard translation procedures for the questionnaires were undertaken to ensure comparability between countries. Sampling weights were calculated to adjust for the population structure as reported by the United Nations Statistical Division. Ethical approval was obtained from the WHO Ethical Review Committee and local ethics research review boards. Written informed consent was obtained from all participants. The survey response rate ranged from 51% (Mexico) to 93% (China).

Depression

Questions based on the World Mental Health Survey version of the Composite International Diagnostic Interview (Kessler and Ustun, 2004) were used for the endorsement of past 12-month Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV depression (American Psychiatric Association, 2000) (Details provided in **eTable 1**). Individuals who reported to have received a lifetime diagnosis of depression and treatment for it in the past 12 months were also considered to have depression.

Sedentary behavior

In order to assess SB, participants were asked to state how much time they spent usually (expressed in minutes per day) sitting or reclining in total including at work, at home, getting to and from places, or with friends (sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television). This did not include time spent sleeping. This single item is derived from the Global Physical Activity Questionnaire (GPAQ) (Armstrong and Bull, 2006). SB is reported as a continuous variable (minutes per day) and also as a categorical [<8 or ≥8 hours per day (highly sedentary)] variable. The 8 hours cut-off was chose as previous research indicated that being sedentary

for 8 or more hours is associated with a higher risk for premature mortality (Ekelund et al., 2016a). The GPAQ is a suitable and acceptable instrument for monitoring SB in population health surveillance systems (Bull et al., 2009).

Sociodemographic variables

These included age, sex, highest level of education achieved (completed secondary or less), wealth, marital status [married/cohabiting or else (never married, separated, divorced, or widowed)], setting (urban or rural), and employment status (engaged in paid work ≥2 days in last 7 days: Y/N). Wealth quintiles were created based on country-specific income.

Health behavior

These comprised of current drinking [alcohol use in the past 30 days (Y/N)], fruit and vegetable intake [≥2 (fruits) and ≥3 (vegetables) servings/day (adequate)] (Joint FAO/WHO Expert Consultation, 2003), and smoking (never, quit, current) (Koyanagi et al., 2015b).

Mental health

Anxiety was assessed by the question 'Overall in the past 30 days, how much of a problem did you have with worry or anxiety' with response alternatives: none, mild, moderate, severe, and extreme. In accordance with previous publications using a dataset with the identical question, those who answered severe and extreme were considered to have anxiety (Stubbs et al., 2017b; Vancampfort et al., 2017a). The presence of mild cognitive impairment (MCI) was assessed with three tests (immediate recall, verbal fluency, and delayed recall) adapted from the validated CERAD (Sosa et al., 2009). Respondents were classified as having MCI if their test score was <lowest 7^{th} percentile (approximately <-1.5 SD) for their age and country in any of these tests (Garin et al., 2016). Those having severe or extreme problems with sleeping, such as falling asleep, waking up frequently during the night or waking up too early in the morning, were considered to have sleep problems (Koyanagi and Stickley, 2015b).

Physical health

A stadiometer and a routinely calibrated electronic weighting scale were used to measure height and weight respectively. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, and categorized as <18.5 (underweight), 18.5-24.9 (normal), 25.0-29.9 (overweight), and ≥30 (obese) kg/m^2. Participants who had severe or extreme bodily aches or pains in the past 30 days were considered to have bodily pain (Koyanagi and Stickley, 2015a). Chronic back pain was defined as having had back pain every day during the last 30 days

(Stubbs et al., 2016a). Fall-related injuries in the past 12 months were assessed with questions on the presence of bodily injury and cause (Stewart Williams et al., 2015). The participant was considered to have hearing problems if the interviewer observed this condition. Visual impairment was defined as having extreme difficulty in seeing and recognizing a person that the participant knows across the road (Freeman et al., 2013). Diabetes and stroke were solely based on lifetime self-reported diagnosis. Blood pressure was measured three times with a one-minute interval with the use of a wrist blood pressure monitor. Hypertension was defined as having at least one of: systolic blood pressure ≥140 mmHg; diastolic blood pressure ≥90 mmHg; or self-reported diagnosis. For angina, arthritis, asthma, and COPD, the participant was considered to have the condition in the presence of self-reported diagnosis and/or symptom-based diagnosis using algorithms. Specifically, the validated Rose questionnaire was used for angina (Rose, 1962), and other previously validated symptom-based algorithms were used for arthritis, asthma, and COPD (Arokiasamy et al., 2017; Moussavi et al., 2007).

Health status

Self-rated health was evaluated by the question 'In general, how would you rate your health today?' Those who answered 'bad' or 'very bad' were considered to have poor self-rated health. Disability was assessed by standard basic activities of daily living (ADL) questions derived from validated instruments (Al Snih et al., 2010; Backholer et al., 2012; Katz et al., 1963) which included six questions with the introductory phrase "overall in the last 30 days, how much difficulty did you have" followed by: in washing your whole body?; in getting dressed?; with moving around inside your home?; with eating (including cutting up your food)?; with getting up from lying down?; with getting to and using the toilet? Answer options were none, mild, moderate, severe, extreme/cannot do. ADL disability was a dichotomous variable where those who answered severe or extreme/cannot do to any of the six questions were considered to have limitations in ADL (Koyanagi et al., 2015a).

Social cohesion

As in a previous SAGE publication (Zamora-Macorra et al., 2017), a social cohesion index was created based on 9 questions on the participant's involvement in community activities in the past 12 months (e.g., attended religious services, club, society, union etc) with answer options 'never (coded=1)', 'once or twice per year (coded=2)', 'once or twice per month (coded=3)', 'once or twice per week (coded=4)', and 'daily (coded=5)'. The answers to these questions were summed and later converted to a scale ranging from 0-100 with higher scores corresponding to higher levels of social cohesion (Cronbach's α=0.78). Four groups were created based on the quartiles.

Statistical analysis

The analysis was restricted to those who had depression (see definition above). The difference in sample characteristics between those being sedentary less than 8 hours versus 8 hours or more was tested by Chi-squared tests. We used past literature as a guide to select the correlates of SB (Vancampfort et al., 2015b). Multivariable logistic and linear regression was used to assess the association between each correlate (exposure) and SB (outcome). The logistic regression analysis used the binary SB variable (i.e. <8 or ≥8 hours/day) as the outcome while the linear regression analysis used the continuous variable (min/day of SB) as the outcome. First, the sociodemographic correlates of SB were assessed by including all the sociodemographic variables (age, sex, education, wealth, marital status, setting, unemployment) in a single model. For factors other than sociodemographic variables (i.e. health and social cohesion), the variables were included individually in the models while adjusting for the sociodemographic correlates which were identified as significant in either the logistic or linear regression model (sex, age, marital status, unemployment). All regression analyses were adjusted for country by including dummy variables for each country (Koyanagi et al., 2014). All variables were included in the models as categorical variables with the exception of the variable on min/day of SB and age (continuous variables). The sample weighting and the complex study design were taken into account in all analyses by the use of the svy command in Stata. Results from the regression analyses are presented as odds ratios (ORs) with 95% confidence intervals (CIs). The statistical analysis was done with Stata 14.1 (Stata Corp LP, College station, Texas). The level of statistical significance was set at $P<0.05$.

Results

The final sample consisted of 2375 individuals with depression (China n=171; Ghana n=347; India n=1114; Mexico n=304; Russia n=265; South Africa n=174). The mean (SD) age of the sample was 48.0 (16.5) years and 60.7% were females (see Table 1). The prevalence of high SB (i.e., ≥8 hours/day) was 11.1% (95%CI=8.2%-14.9%), while the mean (SD) time spent sedentary was 215 (192) min per day. Based on unadjusted estimates, the prevalence of older individuals and those who are not married/cohabiting were significantly higher among those with high SB (**Table 1**), while the prevalence of sleep problems, bodily pain, arthritis, COPD, hearing problems, stroke, visual impairment, poor self-rated health, disability, and low social cohesion were also significantly higher (**Table 2**). The significant sociodemographic correlates of high SB based on the logistic regression model were older age and never being married (vs. married/cohabiting) while the significant sociodemographic correlates of longer time engaged in SB (min/day) were older age, male sex, never being married (vs. married/cohabiting) and unemployment based on the linear regression model (**Table 3**).

As for correlates other than those of the sociodemographic domain, based on the logistic regression analysis, no alcohol consumption, current smoking (vs. never), MCI, bodily pain, arthritis, stroke, disability, and lower levels of social cohesion were significantly associated with high SB (**Table 4**). Based on the linear regression analysis, those

with depression having MCI, bodily pain, arthritis, COPD, visual impairment, poor self-rated health, disability, and lower levels of social cohesion were significantly more likely to spend more time sedentary.

Discussion

General findings

To the authors' knowledge, the current study is the first to explore correlates of SB among individuals with depression in LMICs. Approximately 11% of people with depression spent 8 or more hours a day being sedentary while the mean time spent sedentary was 215 (192) min/day. The sociodemographic correlates significantly associated with being more sedentary in the categorical (less than versus 8 or more hours sedentary) and/or continuous (minutes per day) analyses were male gender, older age, not/never being married/cohabiting, and being unemployed.

In contrast to the "Western" literature where women tend to be more sedentary in the general population, the current data in LMICs clearly demonstrate that men with depression are more sedentary than women. It is established that women, in particular from rural settings in LMICs, are at the center of the economic production for the family (Pathai et al., 2013). More research is however needed to clarify this gender difference in LMICs. Nonetheless, the present findings suggest that reducing sedentary time may be especially important in men with depression in LMICs. In terms of age, older age has been associated with higher sedentary time in the general population and this may be related to a higher risk for chronic conditions in people at older age (Vancampfort et al., 2017b). Next, depressed individuals who are not/never married/cohabiting were more sedentary than those who are married/cohabiting. It might be that loneliness, less social connectivity, and lack of social support are underlying reasons as lower levels of social relationships are known to be associated with high SB (Leask et al., 2015) and with depression (Grav et al., 2012). A similar hypothesis can be formulated for associations between being unemployed and being more sedentary as

employment or volunteering work may offer not only opportunities for people with depression to leave their home but also to connect socially, which may enhance social functioning in those lacking energy and motivation.

In our study, lower levels of social cohesion were associated with being more sedentary, as has been found previously in high income countries (Leask et al., 2015). At the individual level, it is important to feel socially connected to the community because it may increase the likelihood that one will take advantage of local opportunities to be engaged in community activities or community work. In the opposite direction, lack of social cohesion may increase SB by reducing the likelihood that one will take advantage of local opportunities to engage in social activities. In a recent systematic review among adolescents in Western settings (Hoare et al., 2016), there was some tentative evidence that SB may be associated with loneliness and isolation perpetuated by excessive screen time use. Whilst this context may not be directly transferable to the current LMICs, it stresses the importance of attempting to understand the context of SB to enable targeted interventions. At the community level, a high level of social cohesion is associated with less crime, and low neighborhood crime rates tend to be associated with people going outdoors more often (Sampson et al., 1997). Also, socially cohesive neighborhoods may be more likely to organize community activities that present opportunities for older people to engage themselves (Cohen et al., 2006).

In other health domains, the significant correlates were no alcohol consumption, current smoking (vs. never), arthritis, stroke, disability, having MCI, bodily pain, arthritis, COPD, visual impairment, and poor self-rated health. Consistent with data from the general population in high income countries (Harvey et al., 2015), we found that the presence of bodily pain (Stubbs et al., 2017a) was associated with increased sedentary time. Chronic pain conditions are leading causes of years lived with disability and a recent meta-analysis demonstrated that 35% and 56% of working and older age adults had chronic pain in LMICs, respectively (Jackson et al., 2015). It is known that people with depression in LMICs may be more likely to have chronic pain (Stubbs et al., 2017c) and treatments that target both pain and depression can lead to better outcomes. For instance, psychological interventions such as cognitive behavioral therapy (Hofmann et al., 2012) or acceptance and commitment therapy (Veehof et al., 2011) may improve coping with pain and depressive symptoms. Moreover, there is robust evidence that exercise can reduce pain and its associated disability (Uthman et al., 2013) and depressive symptoms (Schuch et al., 2016; Schuch et al., 2017). However, a caveat of the aforementioned research is that it has been conducted almost exclusively in high income societies, thus calling to the need for such research in LMICs. Our data offer evidence to investigate whether interventions that reduce pain among those with depression might reduce sedentary time as well.

MCI was another important correlate of high SB in people with depression. Depression (Jorm, 2000) and SB (Falck et al., 2017) are both risk factors for cognitive decline, although this evidence is largely drawn from high-income

populations. The reason why people with depression who present with cognitive problems are more likely to be sedentary is largely unknown. Cognitive problems are associated with impairments in executive functioning and planning and this can result in an increased risk of falls, mainly in older people. Falls are associated with a fear of falling again and avoidance of activities (Shimada et al., 2015). Moreover, people with major depression are known to be at increased risk of falls (Stubbs et al., 2016b). Next to this, cognitive dysfunction might also be a marker of severe depression (Snyder, 2013).

In terms of individual chronic conditions, depressed individuals with angina, asthma, and stroke were more likely to engage in high SB while time spent sedentary was also greater for COPD and visual impairment. It is possible that the symptoms or disability associated with these conditions increase the likelihood that they spend more time sedentary. Interventions to decrease time spent sedentary and increase physical activity may in particular be beneficial for the mental and physical wellbeing for individuals suffering from co-existing depression and physical health conditions. In addition, there is evidence of an inverse dose response relationship between physical activity and multimorbidity and sedentary behavior (Loprinzi, 2015). Future longitudinal research is required to explore isotemporal relationships between sedentary behavior and the aforementioned physical health conditions and multimorbidity to inform future targeted intervention work.

Limitations

The current data should be considered in the light of some limitations. First, the study is cross-sectional, therefore cause and effect cannot be deduced. Thus, future prospective research is required to disentangle the directionality of the relationships we observed. Second, sedentary behavior was measured with a self-report questionnaire, which is known to be less accurate as it may underestimate sedentary levels (Ainsworth et al., 2006). Third, the diagnosis of depression was made using fully structured, trained, lay interviewers rather than clinician-administered interviews. Nevertheless, the clinical SCID-CIDI reappraisal interviews have shown a good concordance in the DSM diagnoses. Also, due to the 12-month timeframe for a depression diagnosis, participants without current depressive symptoms might have been included. Thus, some level of misclassification may have affected the results. Finally, we were unable to conduct country-wise analyses due to the small sample size in the majority of the countries. Future studies should consider examining whether there are between-country differences in the correlates of SB in depressed individuals.

Policy-related and clinical implications

Notwithstanding potential limitations, the present findings offer some implications for community-based and clinical recommendations. First, this study suggests that policy makers should focus on reducing social isolation and stimulating social cohesion to help reduce SB of vulnerable people with mental health problems. This can be done in several ways. In neighborhoods where only a few older residents feel that they belong to the community, SB could be reduced by promoting social engagement among all community members by organizing social activities. In neighborhoods where the overall level of social cohesion is already high, further benefits may be achieved by socially integrating residents who do not feel that they belong. Furthermore, community integration has been associated with the ability to recall disseminated health promotion messages; thus, the promotion of social cohesion may also increase the efficacy of public health initiatives (Viswanath et al., 2006), e.g. focusing on activating people with mental health problems. Second, from a clinical perspective, the current findings suggest that, among adults with depression, health care professionals should consider bodily pain and a wide range of chronic somatic co-morbidities. Special attention should also be given to both depressive men and depressive older patients.

In conclusion, the present findings illustrate that several sociodemographic factors (male gender, older age, being unemployed, not being married/cohabiting), social cohesion, bodily pain and somatic co-morbidity (in particular arthritis and COPD) are associated with sedentary levels among people with depression in six LMICs. These findings provide guidance for future population and clinical level interventions across LMICs to assist people with depression in reducing their SB.

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Contributors

Davy Vancampfort, Brendon Stubbs and Ai Koyanagi designed the study. Ai Koyanagi led the data analysis. Davy Vancampfort, Brendon Stubbs and Ai Koyanagi wrote the manuscript. All authors provided critical comments on the manuscript and approved the final version.

Declaration of interest

The authors have no conflicts of interest to report.

References

Ainsworth, B.E., Macera, C.A., Jones, D.A., Reis, J.P., Addy, C.L., Bowles, H.R., Kohl 3rd, H., 2006. Comparison of the 2001 BRFSS and the IPAQ Physical Activity Questionnaires. Medicine and Science in Sports and Exercise 38, 1584-1592.

Al Snih, S., Graham, J.E., Kuo, Y.F., Goodwin, J.S., Markides, K.S., Ottenbacher, K.J., 2010. Obesity and disability: relation among older adults living in Latin America and the Caribbean. American Journal of Epidemiology 171, 1282-1288.

American Psychiatric Association, 2000. Diagnostic and statistical manual of mental disorders (4th ed.).Washinton DC: American Psychiatric Association.

Arokiasamy, P., Uttamacharya, Kowal, P., Capistrant, B.D., Gildner, T.E., Thiele, E., Biritwum, R.B., Yawson, A.E., Mensah, G., Maximova, T., Wu, F., Guo, Y., Zheng, Y., Kalula, S.Z., Salinas Rodriguez, A., Manrique Espinoza, B., Liebert, M.A., Eick, G., Sterner, K.N., Barrett, T.M., Duedu, K., Gonzales, E., Ng, N., Negin, J., Jiang, Y., Byles, J., Madurai, S.L., Minicuci, N., Snodgrass, J.J., Naidoo, N., Chatterji, S., 2017. Chronic Noncommunicable Diseases in 6 Low- and Middle-Income Countries: Findings From Wave 1 of the World Health Organization's Study on Global Ageing and Adult Health (SAGE). American Journal of Epidemiology 185, 414-428.

Armstrong, T., Bull, F., 2006. Development of the World Health Organization global physical activity questionnaire (GPAQ). Journal of Public Health 14, 66-70.

Atkinson, K., Lowe, S., Moore, S., 2016. Human development, occupational structure and physical inactivity among 47 low and middle income countries. Preventive Medicine Reports 3, 40-45.

Backholer, K., Wong, E., Freak-Poli, R., Walls, H.L., Peeters, A., 2012. Increasing body weight and risk of limitations in activities of daily living: a systematic review and meta-analysis. Obesity Reviews 13, 456-468.

Biswas, A., Oh, P.I., Faulkner, G.E., Bajaj, R.R., Silver, M.A., Mitchell, M.S., Alter, D.A., 2015.

Sedentary Time and Its Association With Risk for Disease Incidence, Mortality, and Hospitalization in Adults: A Systematic Review and Meta-analysis. Annals of Internal Medicine 162, 123-132.

Bull, F.C., Maslin, T.S., Armstrong, T., 2009. Global physical activity questionnaire (GPAQ): nine country reliability and validity study. Journal of Physical Activity and Health 6, 790-804.

Christensen, K., Doblhammer, G., Rau, R., Vaupel, J.W., 2009. Ageing populations: the challenges ahead. Lancet 374, 1196-1208.

Cohen, D.A., Finch, B.K., Bower, A., Sastry, N., 2006. Collective efficacy and obesity: the potential influence of social factors on health. Social science & Medicine 62, 769-778.

Correll, C.U., Solmi, M., Veronese, N., Bortolato, B., Rosson, S., Santonastaso, P., Thapa, N., Fornaro, M., Gallicchio, D., Collantoni, E., Pigato, G., Favaro, A., Monaco, F., Kohler, C., Vancampfort, D., Ward, P.B., Gaughran, F., Carvalho, A.F., Stubbs, B., 2017. Prevalence, incidence and mortality from cardiovascular disease in patients with pooled and specific severe mental illness: a large-scale meta-analysis of 3,211,768 patients and 113,383,368 controls. World Psychiatry 16, 163-180.

Cuijpers, P., Smit, F., 2002. Excess mortality in depression: a meta-analysis of community studies. Journal of Affective Disorders 72, 227 - 236.

Ekelund, U., Steene-Johannessen, J., Brown, W.J., Fagerland, M.W., Owen, N., Powell, K.E., Bauman, A., Lee, I.-M., Series, L.P.A., Group, L.S.B.W., 2016a. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. The Lancet 388, 1302-1310.

Ekelund, U., Steene-Johannessen, J., Brown, W.J., Fagerland, M.W., Owen, N., Powell, K.E., Bauman, A., Lee, I.M., 2016b. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. Lancet 388, 1302-1310.

Falck, R.S., Davis, J.C., Liu-Ambrose, T., 2017. What is the association between sedentary behaviour and cognitive function? A systematic review. British Journal of Sports Medicine 51, 800-811.

Freeman, E.E., Roy-Gagnon, M.H., Samson, E., Haddad, S., Aubin, M.J., Vela, C., Zunzunegui, M.V., 2013. The global burden of visual difficulty in low, middle, and high income countries. PloS One 8, e63315.

Garin, N., Koyanagi, A., Chatterji, S., Tyrovolas, S., Olaya, B., Leonardi, M., Lara, E., Koskinen, S., Tobiasz-Adamczyk, B., Ayuso-Mateos, J.L., Haro, J.M., 2016. Global Multimorbidity Patterns: A Cross-Sectional, Population-Based, Multi-Country Study. The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences 71, 205-214.

Grav, S., Hellzèn, O., Romild, U., Stordal, E., 2012. Association between social support and depression in the general population: the HUNT study, a cross-sectional survey. Journal of Cinical Nursing 21, 111-120.

Guerra, M., Prina, A.M., Ferri, C.P., Acosta, D., Gallardo, S., Huang, Y., Jacob, K.S., Jimenez-Velazquez, I.Z., Llibre Rodriguez, J.J., Liu, Z., Salas, A., Sosa, A.L., Williams, J.D., Uwakwe, R., Prince, M., 2016. A comparative cross-cultural study of the prevalence of late life depression in low and middle income countries. Jounal of Affective Disorders 190, 362-368.

Haro, J.M., Arbabzadeh Bouchez, S., Brugha, T.S., De Girolamo, G., Guyer, M.E., Jin, R., Lepine, J.P., Mazzi, F., Reneses, B., Vilagut, G., 2006. Concordance of the Composite International Diagnostic Interview Version 3.0 (CIDI 3.0) with standardized clinical assessments in the WHO World Mental Health surveys. International Journal of Methods in Psychiatric Research 15, 167-180.

Harvey, J.A., Chastin, S.F., Skelton, D.A., 2015. How sedentary are older people? A systematic review of the amount of sedentary behavior. Journal of Aging and Physical Activity 23, 471-487.

Hawton, K., Casanas, I.C.C., Haw, C., Saunders, K., 2013. Risk factors for suicide in individuals with depression: a systematic review. Journal of Affective Disorders 147, 17-28.

Hoare, E., Milton, K., Foster, C., Allender, S., 2016. The associations between sedentary behaviour and mental health among adolescents: a systematic review. International Journal of Behavioral Nutrition and Physical Activity 13, 108.

Hofmann, S.G., Asnaani, A., Vonk, I.J., Sawyer, A.T., Fang, A., 2012. The efficacy of cognitive behavioral therapy: A review of meta-analyses. Cognitive therapy and Research 36, 427-440.

Jackson, T., Thomas, S., Stabile, V., Han, X., Shotwell, M., McQueen, K., 2015. Prevalence of chronic pain in low-income and middle-income countries: a systematic review and meta-analysis. The Lancet 385, S10.

Joint FAO/WHO Expert Consultation, 2003. Joint WHO/FAO expert consultation on diet, nutrition and the prevention of chronic diseases, Geneva.

Jorm, A.F., 2000. Is depression a risk factor for dementia or cognitive decline? Gerontology 46,

219-227.

Katz, S., Ford, A.B., Moskowitz, R.W., Jackson, B.A., Jaffe, M.W., 1963. Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychosocial function. JAMA : the journal of the American Medical Association 185, 914-919.

Kessler, R.C., Ustun, T.B., 2004. The World Mental Health (WMH) Survey Initiative Version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). International Journal of Methods in Psychiatric Research 13, 93-121.

Kowal, P., Chatterji, S., Naidoo, N., Biritwum, R., Fan, W., Lopez Ridaura, R., Maximova, T., Arokiasamy, P., Phaswana-Mafuya, N., Williams, S., Snodgrass, J.J., Minicuci, N., D'Este, C., Peltzer, K., Boerma, J.T., 2012. Data resource profile: the World Health Organization Study on global AGEing and adult health (SAGE). International Journal of Epidemiology 41, 1639-1649.

Koyanagi, A., Garin, N., Olaya, B., Ayuso-Mateos, J.L., Chatterji, S., Leonardi, M., Koskinen, S., Tobiasz-Adamczyk, B., Haro, J.M., 2014. Chronic conditions and sleep problems among adults aged 50 years or over in nine countries: a multi-country study. PloS one 9, e114742.

Koyanagi, A., Moneta, M.V., Garin, N., Olaya, B., Ayuso-Mateos, J.L., Chatterji, S., Leonardi, M., Sainio, P., Galas, A., Haro, J.M., 2015a. The association between obesity and severe disability among adults aged 50 or over in nine high-income, middle-income and low-income countries: a cross-sectional study. BMJ Open 5, e007313.

Koyanagi, A., Stickley, A., 2015a. The association between psychosis and severe pain in community-dwelling adults: Findings from 44 low- and middle-income countries. Journal of Psychiatric Research 69, 19-26.

Koyanagi, A., Stickley, A., 2015b. The Association between Sleep Problems and Psychotic Symptoms in the General Population: A Global Perspective. Sleep 38, 1875-1885.

Koyanagi, A., Stickley, A., Garin, N., Miret, M., Ayuso-Mateos, J.L., Leonardi, M., Koskinen, S., Galas, A., Haro, J.M., 2015b. The association between obesity and back pain in nine countries: a cross-sectional study. BMC Public Health 15, 123.

Leask, C.F., Harvey, J.A., Skelton, D.A., Chastin, S.F., 2015. Exploring the context of sedentary behaviour in older adults (what, where, why, when and with whom). European Review of Aging and Physical Activity 12, 4.

Loprinzi, P.D., 2015. Sedentary behavior and medical multimorbidity. Physiology & behavior 151,

395-397.

Loyen, A., Verloigne, M., Van Hecke, L., Hendriksen, I., Lakerveld, J., Steene-Johannessen, J., Koster, A., Donnelly, A., Ekelund, U., Deforche, B., De Bourdeaudhuij, I., Brug, J., van der Ploeg, H.P., 2016. Variation in population levels of sedentary time in European adults according to cross-European studies: a systematic literature review within DEDIPAC. International Journal of Behavioral Nutrition and Physical Activity 13, 71.

Moussavi, S., Chatterji, S., Verdes, E., Tandon, A., Patel, V., Ustun, B., 2007. Depression, chronic diseases, and decrements in health: results from the World Health Surveys. Lancet 370, 851-858.

O'Donoghue, G., Perchoux, C., Mensah, K., Lakerveld, J., van der Ploeg, H., Bernaards, C., Chastin, S.F., Simon, C., O'Gorman, D., Nazare, J.-A., 2016. A systematic review of correlates of sedentary behaviour in adults aged 18–65 years: a socio-ecological approach. BMC Public Health 16, 163.

Pathai, S., Gilbert, C., Weiss, H.A., Cook, C., Wood, R., Bekker, L.-G., Lawn, S.D., 2013. Frailty in HIV-infected adults in South Africa. Journal of acquired immune deficiency syndromes (1999) 62, 43.

Pengpid, S., Peltzer, K., Kassean, H.K., Tsala Tsala, J.P., Sychareun, V., Muller-Riemenschneider, F., 2015. Physical inactivity and associated factors among university students in 23 low-, middle- and high-income countries. International Journal of Public Health 60, 539-549.

Prince, S., Reed, J., McFetridge, C., Tremblay, M., Reid, R., 2017. Correlates of sedentary behaviour in adults: a systematic review. Obesity Reviews.

Rhodes, R.E., Mark, R.S., Temmel, C.P., 2012. Adult sedentary behavior: a systematic review. American Journal of Preventive Medicine 42, e3-e28.

Rose, G.A., 1962. The diagnosis of ischaemic heart pain and intermittent claudication in field surveys. Bulletin of the World Health Organization 27, 645-658.

Sallis, J.F., Bull, F., Guthold, R., Heath, G.W., Inoue, S., Kelly, P., Oyeyemi, A.L., Perez, L.G., Richards, J., Hallal, P.C., 2016. Progress in physical activity over the Olympic quadrennium. Lancet.

Sampson, R.J., Raudenbush, S.W., Earls, F., 1997. Neighborhoods and violent crime: A multilevel study of collective efficacy. Science 277, 918-924.

Schuch, F., Vancampfort, D., Firth, J., Rosenbaum, S., Ward, P., Reichert, T., Bagatini, N.C., Bgeginski, R., Stubbs, B., 2017. Physical activity and sedentary behavior in people with major depressive disorder: A systematic review and meta-analysis. Journal of Affective Disorders 210, 139-150.

Schuch, F.B., Vancampfort, D., Richards, J., Rosenbaum, S., Ward, P.B., Stubbs, B., 2016.

Exercise as a treatment for depression: a meta-analysis adjusting for publication bias. Journal of Psychiatric Research 77, 42-51.

Shimada, H., Park, H., Makizako, H., Tsutsumimoto, K., Uemura, K., Nakakubo, S., Hotta, R., Suzuki, T., 2015. Cognitive function and falling among older adults with mild cognitive impairment and slow gait. Geriatrics & gerontology international 15, 1073-1078.

Snyder, H.R., 2013. Major depressive disorder is associated with broad impairments on neuropsychological measures of executive function: A meta-analysis and review. American Psychological Association.

Sosa, A.L., Albanese, E., Prince, M., Acosta, D., Ferri, C.P., Guerra, M., Huang, Y., Jacob, K.S., de Rodriguez, J.L., Salas, A., Yang, F., Gaona, C., Joteeshwaran, A., Rodriguez, G., de la Torre, G.R., Williams, J.D., Stewart, R., 2009. Population normative data for the 10/66 Dementia Research Group cognitive test battery from Latin America, India and China: a cross-sectional survey. BMC Neurology 9, 48.

Stewart Williams, J., Kowal, P., Hestekin, H., O'Driscoll, T., Peltzer, K., Yawson, A., Biritwum, R., Maximova, T., Salinas Rodriguez, A., Manrique Espinoza, B., Wu, F., Arokiasamy, P., Chatterji, S., 2015. Prevalence, risk factors and disability associated with fall-related injury in older adults in low- and middle-incomecountries: results from the WHO Study on global AGEing and adult health (SAGE). BMC Medicine 13, 147.

Stubbs, B., Koyanagi, A., Thompson, T., Veronese, N., Carvalho, A.F., Solomi, M., Mugisha, J., Schofield, P., Cosco, T., Wilson, N., Vancampfort, D., 2016a. The epidemiology of back pain and its relationship with depression, psychosis, anxiety, sleep disturbances, and stress sensitivity: Data from 43 low- and middle-income countries. General hospital psychiatry 43, 63-70.

Stubbs, B., Stubbs, J., Gnanaraj, S.D., Soundy, A., 2016b. Falls in older adults with major depressive disorder (MDD): a systematic review and exploratory meta-analysis of prospective studies. International Psychogeriatrics 28, 23-29.

Stubbs, B., Koyanagi, A., Hallgren, M., Firth, J., Richards, J., Schuch, F., Rosenbaum, S., Mugisha, J., Veronese, N., Lahti, J., 2017a. Physical activity and anxiety: A perspective from the World Health Survey. Journal of Affective Disorders 208, 545-552.

Stubbs, B., Koyanagi, A., Hallgren, M., Firth, J., Richards, J., Schuch, F., Rosenbaum, S., Mugisha, J., Veronese, N., Lahti, J., Vancampfort, D., 2017b. Physical activity and

anxiety: A perspective from the World Health Survey. Journal of Affective Disorders 208, 545-552.

Stubbs, B., Vancampfort, D., Veronese, N., Kahl, K.G., Mitchell, A.J., Lin, P.Y., Tseng, P.T., Mugisha, J., Solmi, M., Carvalho, A.F., Koyanagi, A., 2017c. Depression and physical health multimorbidity: primary data and country-wide meta-analysis of population data from 190 593 people across 43 low- and middle-income countries. Psychol Med, 1-11.

Stubbs, B., Vancampfort, D., Veronese, N., Thompson, T., Fornaro, M., Schofield, P., Solmi, M., Mugisha, J., Carvalho, A., Koyanagi, A., 2017d. Depression and pain: primary data and meta-analysis among 237 952 people across 47 low-and middle-income countries. Psychological Medicine, 1-12.

Stubbs, B., Vancampfort, D., Firth, J., Schuch, F.B., Hallgren, M., Smith, L., Gardner, B., Kahl, K.G., Veronese, N., Solmi, M., Carvalho, A.F., Koyanagi, A., 2018. Relationship between sedentary behavior and depression: a mediation analysis of influential factors across the lifespan among 42,469 people in low- and middle-income countries. Psychological Medicine.

Tremblay, M.S., Aubert, S., Barnes, J.D., Saunders, T.J., Carson, V., Latimer-Cheung, A.E., Chastin, S.F., Altenburg, T.M., Chinapaw, M.J., 2017. Sedentary Behavior Research Network (SBRN)–Terminology Consensus Project process and outcome. International Journal of Behavioral Nutrition and Physical Activity 14, 75.

Uthman, O.A., van der Windt, D.A., Jordan, J.L., Dziedzic, K.S., Healey, E.L., Peat, G.M., Foster, N.E., 2013. Exercise for lower limb osteoarthritis: systematic review incorporating trial sequential analysis and network meta-analysis. BMJ 347, f5555.

Vancampfort, D., Correll, C.U., Galling, B., Probst, M., De Hert, M., Ward, P.B., Rosenbaum, S., Gaughran, F., Lally, J., Stubbs, B., 2016. Diabetes mellitus in people with schizophrenia, bipolar disorder and major depressive disorder: a systematic review and large scale meta-analysis. World Psychiatry 15, 166-174.

Vancampfort, D., Koyanagi, A., Hallgren, M., Probst, M., Stubbs, B., 2017a. The relationship between chronic physical conditions, multimorbidity and anxiety in the general population: A global perspective across 42 countries. General Hospital Psychiatry 45, 1-6.

Vancampfort, D., Koyanagi, A., Ward, P.B., Rosenbaum, S., Schuch, F.B., Mugisha, J., Richards, J., Firth, J., Stubbs, B., 2017b. Chronic physical conditions, multimorbidity and physical activity across 46 low- and middle-income countries. International Journal of Behavioral Nutrition and Physical Activity 14, 6.

Vancampfort, D., Stubbs, B., Mitchell, A.J., De Hert, M., Wampers, M., Ward, P.B., Rosenbaum,

S., Correll, C.U., 2015a. Risk of metabolic syndrome and its components in people with schizophrenia and related psychotic disorders, bipolar disorder and major depressive disorder: a systematic review and meta-analysis. World Psychiatry: Official Journal Of The World Psychiatric Association (WPA) 14, 339-347.

Vancampfort, D., Stubbs, B., Sienaert, P., Wyckaert, S., De Hert, M., Rosenbaum, S., Probst, M., 2015b. What are the factors that influence physical activity participation in individuals with depression? A review of physical activity correlates from 59 studies. Psychiatria Danubina 27, 0-224.

Veehof, M.M., Oskam, M.-J., Schreurs, K.M., Bohlmeijer, E.T., 2011. Acceptance-based interventions for the treatment of chronic pain: a systematic review and meta-analysis. PAIN® 152, 533-542.

Viswanath, K., Randolph Steele, W., Finnegan Jr, J.R., 2006. Social capital and health: Civic engagement, community size, and recall of health messages. American Journal of Public Health 96, 1456-1461.

Whiteford, H.A., Ferrari, A.J., Degenhardt, L., Feigin, V., Vos, T., 2015. The global burden of mental, neurological and substance use disorders: an analysis from the Global Burden of Disease Study 2010. PLoS One 10, e0116820.

Wirth, K., Klenk, J., Brefka, S., Dallmeier, D., Faehling, K., i Figuls, M.R., Tully, M.A., Giné-Garriga, M., Caserotti, P., Salvà, A., 2016. Biomarkers associated with sedentary behaviour in older adults: a systematic review. Ageing Research Reviews.

World Bank, 2003. Classification of economies. World Bank, Washington DC.

Zamora-Macorra, M., de Castro, E.F., Avila-Funes, J.A., Manrique-Espinoza, B.S., Lopez-Ridaura, R., Sosa-Ortiz, A.L., Shields, P.L., Del Campo, D.S., 2017. The association between social support and cognitive function in Mexican adults aged 50 and older. Archives of Gerontology and Geriatrics 68, 113-118.

Zhai, L., Zhang, Y., Zhang, D., 2015. Sedentary behaviour and the risk of depression: a meta-analysis. British Journal of Sports Medicine 49, 705-709.

Table 1 Sociodemographic characteristics of the sample (overall and by presence or absence of highly sedentary behavior)

			Highly sedentary[a]		
Characteristic	Category	Overall	No	Yes	P-value[b]

Age (years)	18-39	27.4	28.2	21.1	0.007
	40-64	56.6	58.0	45.7	
	≥65	16.0	13.8	33.2	
Sex	Female	60.7	61.0	58.3	0.733
Education	≥Secondary completed	39.3	38.6	45.2	0.423
Wealth	Poorest	23.0	23.7	17.7	0.569
	Poorer	22.7	22.2	26.8	
	Middle	19.6	19.7	18.8	
	Richer	16.1	16.5	12.4	
	Richest	18.6	17.9	24.3	
Marital status	Married/cohabiting	70.7	73.1	51.6	0.003
Setting	Rural	62.3	62.9	57.5	0.521
Unemployed	Yes	51.8	49.9	67.1	0.056

Data are column % based on weighted estimates.
[a] Those reporting 8 or more hours per day spent sedentary were considered to be highly sedentary.
[b] The difference in sample characteristics by sedentary behavior was tested by Chi-squared tests.

Table 2 Sample characteristics of the health and social cohesion domains (overall and by presence or absence of highly sedentary behavior)

Characteristic	Category	Overall	Highly sedentary[a] No	Yes	P-value[b]
Health behavior					
Alcohol consumption	Yes	11.4	12.1	6.1	0.074
Fruit and vegetable consumption	Not adequate	88.9	89.2	86.0	0.620
Smoking	Never	55.1	56.5	43.7	0.298
	Current smoker	38.1	37.0	46.6	
	Former smoker	6.8	6.4	9.7	
Mental health					
Anxiety	Yes	39.7	38.9	45.7	0.364
Mild cognitive impairment	Yes	66.2	66.7	61.9	0.440
Sleep problems	Yes	22.9	21.5	33.3	0.048
Physical health					
BMI (kg/m^2)	Normal	46.0	45.1	54.4	0.101
	Overweight	13.6	12.7	20.8	
	Obese	6.6	7.0	3.5	
	Underweight	33.8	35.3	21.3	
Bodily pain	Yes	29.7	27.0	50.5	0.001*
Angina	Yes	27.6	26.4	36.8	0.124
Arthritis	Yes	33.8	31.3	53.6	0.002*
Asthma	Yes	17.0	16.9	16.9	0.991
Chronic back pain	Yes	18.2	17.2	25.9	0.194
COPD	Yes	28.9	27.3	41.2	0.047*
Diabetes	Yes	7.9	7.9	7.8	0.984
Fall-related injury	Yes	11.2	10.7	15.3	0.334
Hearing problems	Yes	3.5	2.9	8.5	0.001*

Hypertension	Yes	34.5	33.9	39.3	0.411
Stroke	Yes	2.1	1.7	5.8	0.001*
Visual impairment	Yes	2.8	2.3	6.4	0.022*
Health status					
Poor self-rated health	Yes	29.6	27.4	46.4	0.007*
Disability	Yes	17.1	15.4	30.4	0.001*
Social cohesion					
Social cohesion (quartile)	1st (lowest)	30.5	28.0	50.6	0.001*
	2nd	22.5	21.6	29.4	
	3rd	19.4	20.9	7.2	
	4th (highest)	27.6	29.5	12.7	

Abbreviation: BMI Body Mass Index
Data are column % based on weighted estimates.
[a] Those reporting 8 or more hours per day spent sedentary were considered to be highly sedentary.
[b] The difference in sample characteristics by sedentary behavior was tested by Chi-squared tests.
* p<0.05

Table 3 Associations between sociodemographic factors and sedentary levels

		Logistic regression		Linear regression	
		Outcome (highly sedentary)[a]		**Outcome (min/day sedentary)**	
Characteristic	**Category**	OR	95%CI	b-coefficient	95%CI
Age (years)	per one-year increase	1.02**	[1.01,1.04]	1.36**	[0.53,2.20]
Sex	Male vs. Female	1.77	[0.94,3.32]	61.26***	[29.34,93.18]
Education	≥Secondary completed vs. <Secondary completed	0.92	[0.45,1.89]	3.69	[-29.90,37.28]
Wealth	Poorer vs. Poorest	2.01	[0.94,4.28]	25.22	[-16.12,66.56]
	Middle vs. Poorest	1.23	[0.52,2.95]	-3.66	[-37.35,30.03]
	Richer vs. Poorest	0.85	[0.37,1.96]	-21.46	[-62.24,19.33]
	Richest vs. Poorest	1.70	[0.71,4.07]	15.80	[-24.03,55.63]
Marital status	Not married/cohabiting vs. Married/cohabiting	3.01***	[1.74,5.21]	36.57*	[5.92,67.21]
Setting	Urban vs. Rural	0.72	[0.30,1.70]	6.04	[-29.97,42.06]
Unemployed	Yes vs. No	1.91	[0.92,3.97]	63.51***	[35.27,91.74]

Abbreviation: OR Odds Ratio; CI Confidence Interval. Models are mutually adjusted for all variables in the table and country.
[a] Those reporting 8 or more hours per day spent sedentary were considered to be highly sedentary.
* p<0.05, **p<0.01, *** p<0.001

Table 4 Associations of health variables and social cohesion with sedentary levels

		Logistic regression		Linear regression	
		Outcome (highly sedentary)[a]		**Outcome (min/day sedentary)**	
Characteristic	**Category**	OR	95%CI	b-coefficient	95%CI

Health behavior					
Alcohol consumption	Yes vs. No	0.37*	[0.14,0.97]	-57.49***	[-91.46,-23.51]
Fruit and vegetable consumption	Not adequate vs. Adequate	1.34	[0.41,4.43]	-0.07	[-46.80,46.65]
Smoking	Current smoker vs. Never	2.43*	[1.16,5.13]	11.03	[-20.00,42.06]
	Former smoker vs. Never	2.31	[0.72,7.40]	10.45	[-42.55,63.44]
Mental health					
Anxiety	Yes vs. No	1.52	[0.84,2.76]	26.10	[-4.34,56.54]
Mild cognitive impairment	Yes vs. No	2.41**	[1.35,4.32]	42.03*	[7.43,76.62]
Sleep problems	Yes vs. No	1.57	[0.88,2.79]	22.87	[-12.10,57.83]
Physical health					
BMI (kg/m^2)	Overweight vs. Normal	1.15	[0.37,3.62]	-1.57	[-39.27,36.13]
	Obese vs. Normal	0.35	[0.12,1.04]	-33.18	[-114.38,48.03]
	Underweight vs. Normal	0.57	[0.30,1.07]	-8.67	[-35.64,18.30]
Bodily pain	Yes vs. No	3.72***	[1.85,7.48]	51.64***	[21.15,82.13]
Angina	Yes vs. No	1.22	[0.67,2.21]	8.64	[-19.38,36.66]
Arthritis	Yes vs. No	1.85*	[1.01,3.38]	32.93*	[2.53,63.34]
Asthma	Yes vs. No	1.13	[0.64,1.99]	-0.03	[-34.07,34.01]
Chronic back pain	Yes vs. No	1.58	[0.72,3.45]	-5.16	[-38.88,28.57]
COPD	Yes vs. No	1.58	[0.84,2.97]	27.95*	[0.96,54.94]
Diabetes	Yes vs. No	0.80	[0.39,1.65]	-10.08	[-70.67,50.51]
Fall-related injury	Yes vs. No	1.7	[0.76,3.82]	1.77	[-39.04,42.57]
Hearing problems	Yes vs. No	1.36	[0.66,2.81]	-4.20	[-64.97,56.56]
Hypertension	Yes vs. No	0.90	[0.49,1.65]	-0.95	[-29.47,27.57]
Stroke	Yes vs. No	2.67*	[1.13,6.33]	63.81	[-7.41,135.04]
Visual impairment	Yes vs. No	2.16	[0.80,5.86]	94.32***	[38.82,149.81]
Health status					
Poor self-rated health	Yes vs. No	1.63	[0.91,2.93]	58.68***	[25.51,91.85]
Disability	Yes vs. No	2.53**	[1.44,4.45]	68.36***	[30.49,106.24]
Social cohesion (quartiles)	2nd vs. 1st (lowest)	1.12	[0.53,2.36]	-26.69	[-66.70,13.32]
	3rd vs. 1st	0.32*	[0.12,0.82]	-55.97***	[-88.72,-23.23]
	4th (highest) vs. 1st	0.39*	[0.16,0.98]	-61.41***	[-97.70,-25.13]

Abbreviation: OR Odds Ratio; CI Confidence Interval; BMI Body Mass Index
Models are adjusted for sex, age, marital status, unemployment, and country.
[a] Those reporting 8 or more hours per day spent sedentary were considered to be highly sedentary.
* p<0.05, ** p<0.01, *** p<0.001

eTable 1 Questions and answer options used for endorsement of DSM-IV depression

1. At least one of the two following symptoms in the last 12 months:

(a) A period, lasting several days, of feeling sad, empty or depressed

(b) A period lasting several days with a loss of interest in most things the participant usually enjoys such as personal relationships, work or hobbies/recreation

AND

2. The period of sadness/loss of interest/low energy lasted for more than two weeks and was most of the day and nearly every day

AND

3. Five or more of the following symptoms:

(a) Loss of appetite

(b) Insomnia (problems falling asleep or waking up too early)

(c) Decreased energy or tiredness all the time

(d) Slowing down in moving around or restless/jittery

(e) Negative feelings/loss of confidence or frequent feelings of hopelessness.

(f) Slowed thinking or difficulties concentrating (e.g., listening to others, working, watching TV, listening to the radio)

(g) Thoughts of death, wishes of own death or suicide attempt

(h) Feelings of sadness, emptiness or depression lasting several days

(i) Anhedonia: loss of interest in things the participant usually enjoys

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Highlights

- Interrupting sedentary time is important in men, those who are not cohabiting and /or unemployed.
- Lack of social cohesion may increase sedentary behaviour in people with depression.
- The presence of bodily pain, arthritis and stroke are associated with being more sedentary in people with depression.